
Excavation at Vadnagar – Cultural Chronology Based on Cultural Materialism and Radiocarbon Dates by AMS

Abhijit S. Ambekar¹, Anindya Sarkar² and Ravi Bhushan³

- ¹. Excavation Branch – V, Archaeological Survey of India, 3rd Floor, VUDA Bhawan, Near L and T Circle, Karelibaug, Vadodara, Gujarat – 390 018, India (Email: abhijeetasi@gmail.com)
 - ². Department of Geology and Geophysics, Indian Institute of Technology Kharagpur, Kharagpur, West Bengal – 721 302, India (Email: sarkaranindya@hotmail.com)
 - ³. Physical Research Laboratory, Navrangpura, Ahmedabad, Gujarat – 380 009, India (Email: bhushan@prl.res.in)
-

Received: 06 July 2023; Revised: 20 September 2023; Accepted: 02 December 2023

Heritage: Journal of Multidisciplinary Studies in Archaeology 12 (2024): 01-26

Abstract: Vadnagar's uniqueness lies in its continuous habitation from pre-2nd century BCE to the present. This uninterrupted occupancy offers a rare opportunity to study cultural transformations over millennia, essential for formulating a cultural index. Recent AMS radiocarbon dating, correlated with stratified cultural material, confirms and refines traditional chronological sequences with absolute dates. Challenges in dating the earliest habitation due to high water-tables were addressed by deeper excavation using core drilling, revealing a sample from 24-25 meters depth in the Darbargadh area. This suggests initial settlement around the mid-8th century BCE. The excavation documents seven cultural periods over 2754 calibrated years, encompassing the Late-Vedic, pre-Buddhist/Mahajanapadas, Mauryan, Indo-Greek, Indo-Scythian (Shaka-Kshatrapas), Maitraka, Chavada, Solanki, Vaghela, Sultanate-Mughal, Gaekwad-British colonial, and contemporary periods. The AMS dates and cultural materials from each stratum demonstrate Vadnagar's continuous habitation despite regional social instability, marking it as India's oldest continuously inhabited site within a single fortification.

Keywords: Excavation, Vadnagar, Habitation, Fortification, Cultural Chronology, Radiocarbon Dates, Religious Structures

Introduction

The excavations conducted at Vadnagar over three consecutive field seasons from 2016-2019 have resulted in a final report comprising two volumes. These outstanding excavation results have led to the formulation of a concept for an Experiential Museum at Vadnagar. The museum is designed to showcase the seven cultural periods of Vadnagar, providing visitors with an experience of archaeological remains through the touch-and-feel medium. A schedule has been prepared, with the ASI responsible for excavating a 4000m² area, while the Gujarat government will develop infrastructure. For this exceptional project, 4 acres of land have been earmarked for acquisition, of which

only 1 acre has been decided for excavation, with the rest kept for infrastructure and allied activities. This land is located on the south-eastern bank of the Sharmistha Lake, in the north-eastern corner of the town (Figure 1).

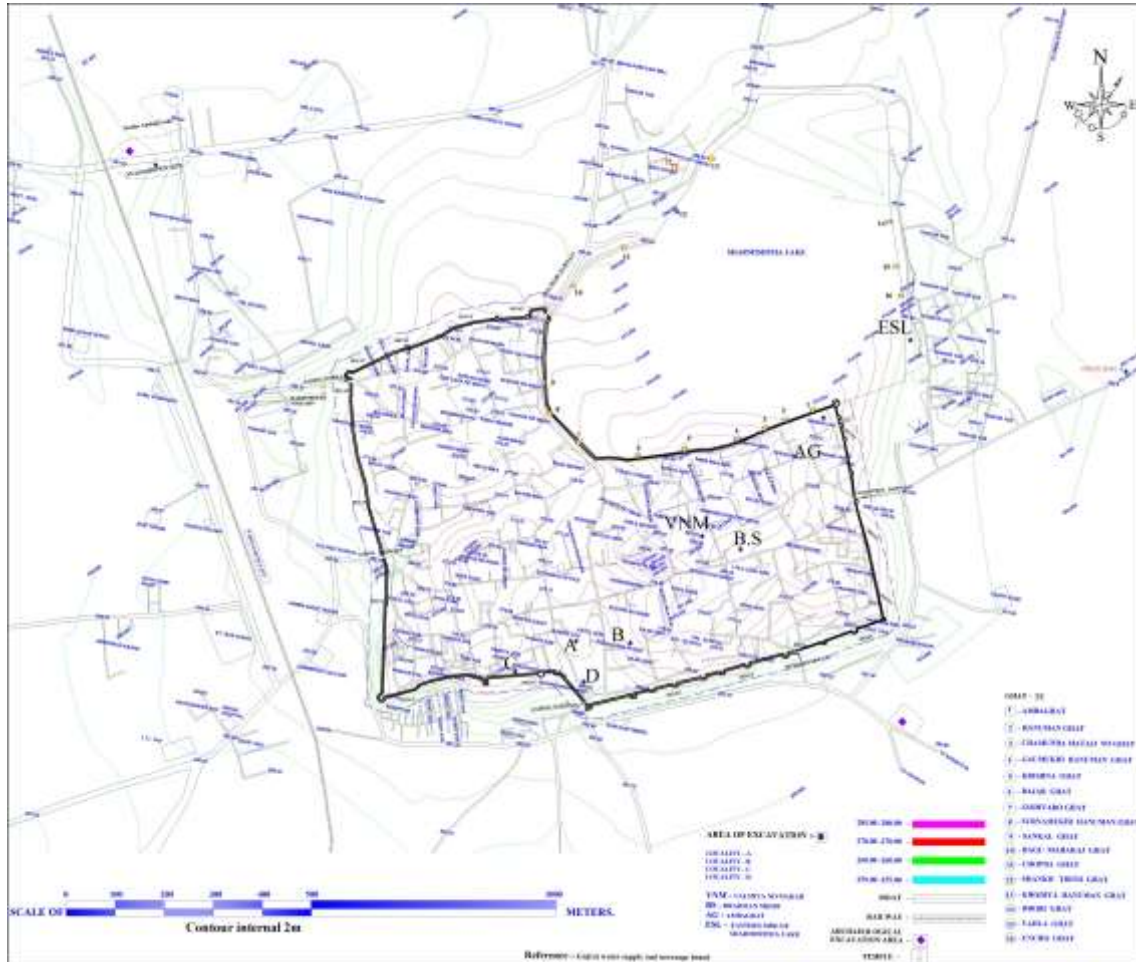


Figure 1: Contour map demarcated with various excavation locations in accordance with different levels of archaeological mound

After the land acquisition process was completed in November 2020, a large-scale excavation covering an area of approximately 3200 square metres was undertaken. In addition to the horizontal large-scale excavation, a 170-metre-long stretch of the fortification wall was also excavated for exposition. For the large-scale horizontal excavation, 24 grids of 10x10m were planned for the field season starting in 2019 and continued till 2022-23 (Figure 2).

In addition to the excavation commenced to create the Experiential Museum on the northeastern side of the town wherein excavation operations were limited to three grids within the proposed Experiential Museum area during the 2019-20 field season (due to ongoing land acquisition processes). However, another excavation site situated outside the fortified town on an elevated mound in the north-western side of Vadnagar, surrounded by the Kotha-Ambaji Lake to the north and Vishnupuri to the south-west

was also subjected to the excavation. This archaeological mound is about 700m away from the fortification wall and is divided into two segments by a road. The northern segment is larger than the southern part, which has been partially damaged due to Anaj Godown's construction activity. This southern segment was subject to excavation during the 2018-19 season and onwards, with 10 grids of 10x10m trenches laid out and 25 quadrants subjected to further excavation (Figure 3).



Figure 2: Grid plan of excavation trenches at Ambaghat locality



Figure 3: Grid plan, south-western of Kotha Ambaji lake

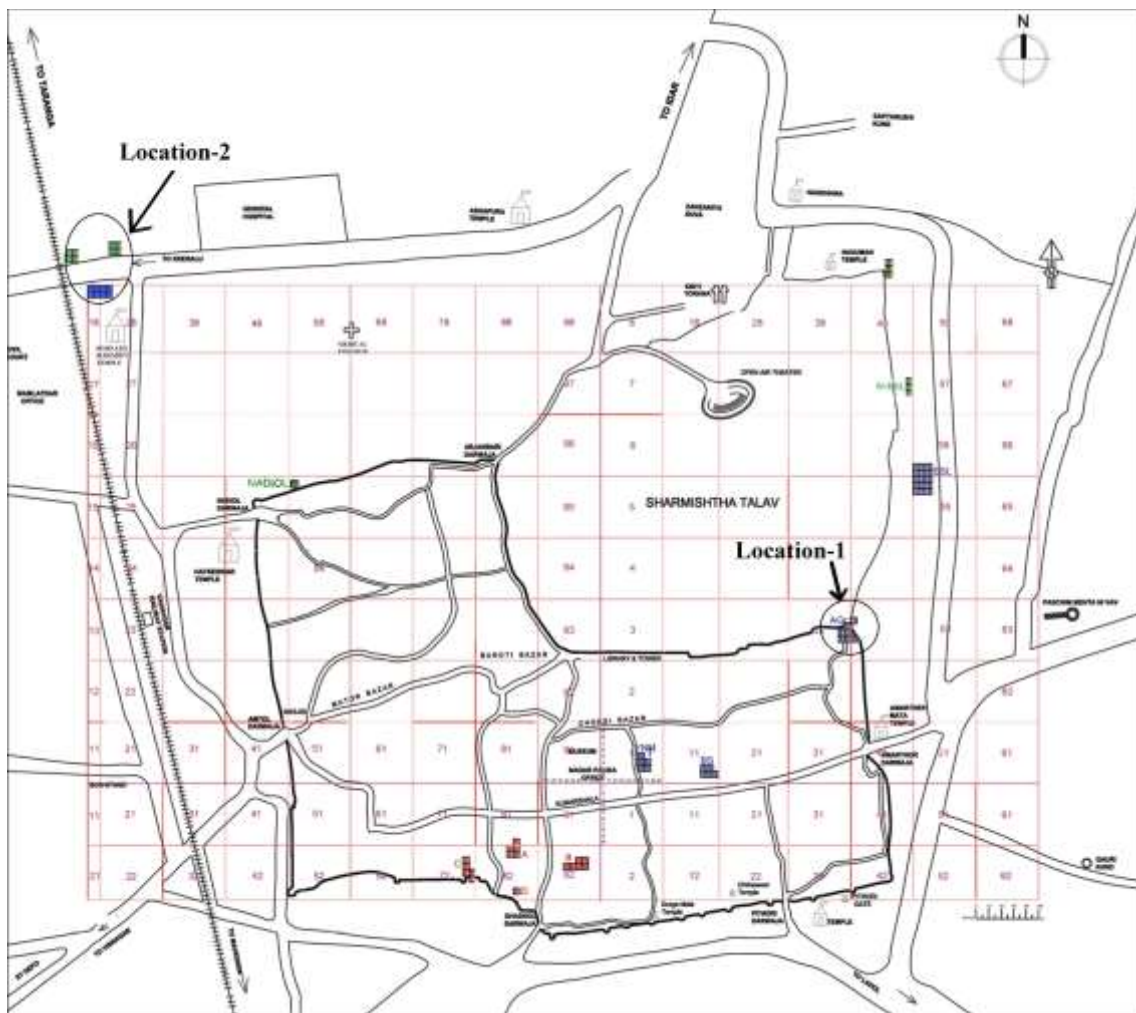


Figure 4: Grid plan of excavation area, Vadnagar

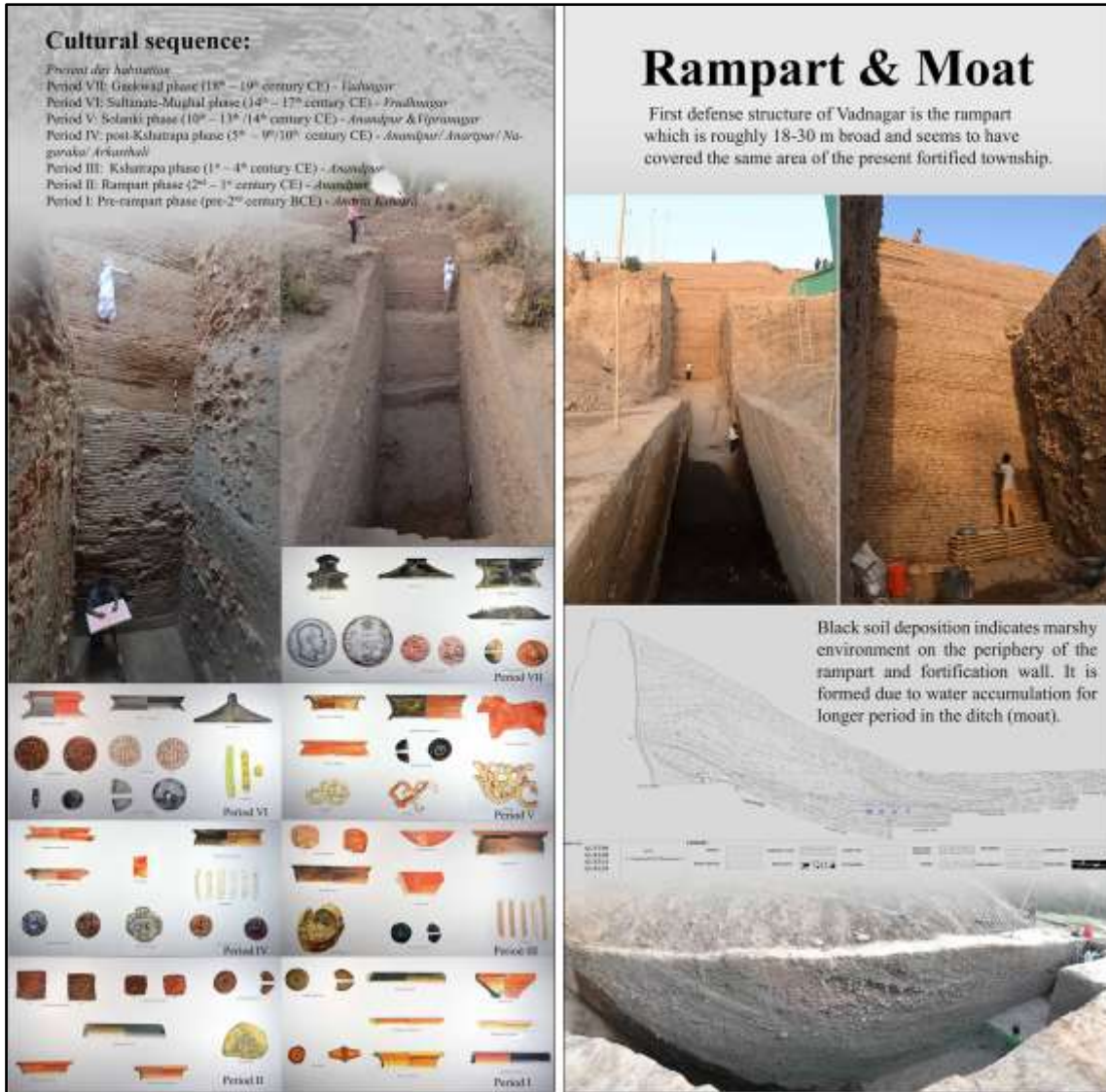


Figure 5: Cultural sequence of Vadnagar

Figure 6: Moat, Rampart and brick fortification wall, Vadnagar

Previous Work

The earliest archaeological findings at the site were noticed in 1952 by Shri S. Ranganath Rao, who reported Red Polished Ware from a disturbed area of the cemetery located to the south of the town. Despite literary and epigraphical evidence of the town, the work of J. Burgess brought to light the town's antiquity through his records. Aligned to this, Shri M. N. Deshpande and Shri R. N. Mehta reported remains of the early historical period on the eastern and northern banks of Sharmistha Lake (Subbarao and R. N. Mehta 1955).

Excavations were conducted by the University of Baroda in 1954 following the reporting of RPW in the area by S. Ranganath Rao in 1952. Two undisturbed mounds, Mound 1 and Mound 2, were selected for excavation by laying out trenches. Mound 1 is located

on the eastern bank of Sharmistha Lake in the *Amarthol* ward of the *Thakar Vasa* area, with the excavation taking place at the mound's northern end. Mound 2, a smaller mound near Gauri Kund, is located further south of Mound 1.

The excavation at the Vadnagar site revealed a continuous sequence of three cultural periods. The earliest period, from 100-200 CE, was characterized by the predominance of very crude pottery, with no RPW found. The subsequent period, from 200-600 CE, marked a flourishing stage with abundant RPW found in the excavation. The uppermost stratum, dated from 600-1000 CE, produced a distinctive coarse red slipped ware with a black design on a white background. This excavation at Vadnagar played a significant role in bridging the gap between Gujarat's proto-historic and early historical periods. (IAR 1953-54, p. 10)

Following a brief break in the process, the Directorate of Archaeology and Museums, Government of Gujarat, led by Shri Y.S. Ravat, conducted large-scale excavations for six consecutive field seasons from 2006 to 2012 at seven locations- three within and four outside the fortified town. The three locations within the fortified area were *Ghaskol Darwaza*, *Durga Mata Temple* and *Khari Kui* (Primary school-3). They yielded more fruitful results for reconstructing the complete cultural sequencing of the site, with a period ranging from approximately the 4th or 3rd century BCE to the present day. The most significant discovery of this excavation was a Buddhist Monastery located within the fortified area of Vadnagar, with some identified commonalities in the planning of a few Buddhist monasteries located in central India and Kolhuva. The monastery appears to have been constructed around c. 1st -2nd century CE and existed in use until 7th-8th century CE. Many antiquities of the Buddhist faith have been recovered from this monastery site. (Rawat, 2011)

Even after the excavation at Vadnagar in the 1950s and the 2010s, the findings of Vadnagar, along with the continuous occupation of the site for over 2200 years, have attracted researchers in the archaeological and historical potential of the field. In the third instance, further excavation at Vadnagar was undertaken by the Archaeological Survey of India, Excavation Branch – V, Vadodara, from 2014 onwards. In the first two field seasons, i.e. 2014-15 and 2015-16, excavations were focused primarily on the outskirts of the ancient town of Vadnagar under the direction of Dr. Madhulika Samanta. The excavations in the following seasons took place within the core area of this township, with the excavation at Ghaskol locality in season 2016-17 and the excavations at Darbargadh, Ambaghat and Eastern side of Sharmistha Lake in Vadnagar in 2017-18. During the 2018-19 season, excavations were conducted on the northern portion of the eastern side of Sharmistha Lake, as well as on a smaller scale near the Nadiol Gate and along the railway track in Vadnagar (Figure 4). The findings from these excavation field seasons have been compiled over two volumes.

Identifying seven cultural periods at Vadnagar was one of the most significant results from the 2016-19 field seasons. Period I – pre 2nd century BCE, Period II – 2nd century

BCE - 1st century CE, Period III – 1st-4th century CE, Period IV – 5th -9th/10th century CE, Period V – 10th-13th century CE, Period VI - 14th-17th century CE, Period VII - 17th/18th -19th century CE (Figure 5).

The excavation findings revealed that this town's early settlers were contemporaries of the pre-Mauryan & Mauryan Empire and had no defence protection. Around the 2nd century BCE, evidence suggests the introduction of the first defence structure as rampart (earthen). This rampart (earthen) was later converted into a brick fortification, indicating the beginning of an era of development from the 1st century CE onwards (Figures 6 and 7).

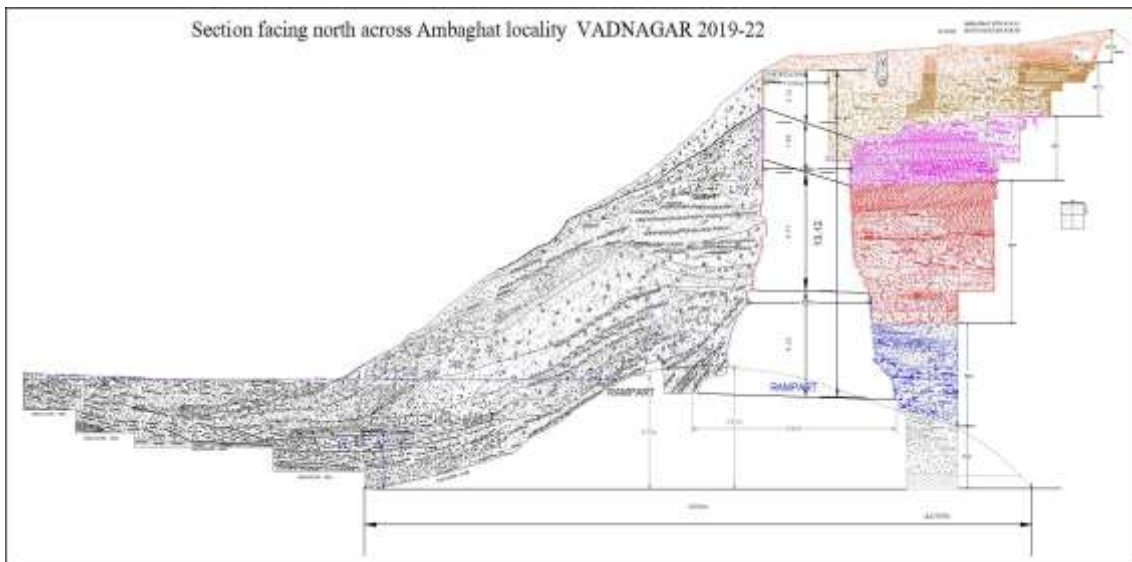


Figure 7: Section across the Fortification, Rampart and Moat, Ambaghat locality

This rampart (earthen) is identified as one of the earliest defence structures of Vadnagar. AMS dating from this cultural layer belongs to the 2nd century BCE, which could imply that this is the earliest defence structure built in Gujarat. As evidenced by the excavated cultural assemblage, the prosperity of this town continued to grow throughout the 4th-5th century CE, culminating in the golden era of Gujarat seen during the Solanki phase of the 10th -13th century CE.

The excavation confirmed the continuity of cultural habitation for over 2500 years. The knowledge of a water harvesting system could explain its persistence. It has been observed that the large settlements from the post-Gupta period were either abandoned or reduced to small villages. This period was identified as one of de-urbanisation and the emergence of new villages (Dhavalikar 1999). A plausible explanation is that it occurred due to severe climate change (aridity in climate). However, Vadnagar presented a different picture compared to the other regions. This town withstood the vagaries of climate change. The reason for this was their ancient knowledge of water harvesting systems, which enabled them to withstand the infrequent monsoons. Around 54 artificial water bodies have been recorded within a 10 km radius of Vadnagar town

that demonstrate the townships ability to withstand adverse climatic conditions even in the past (Figure 8).

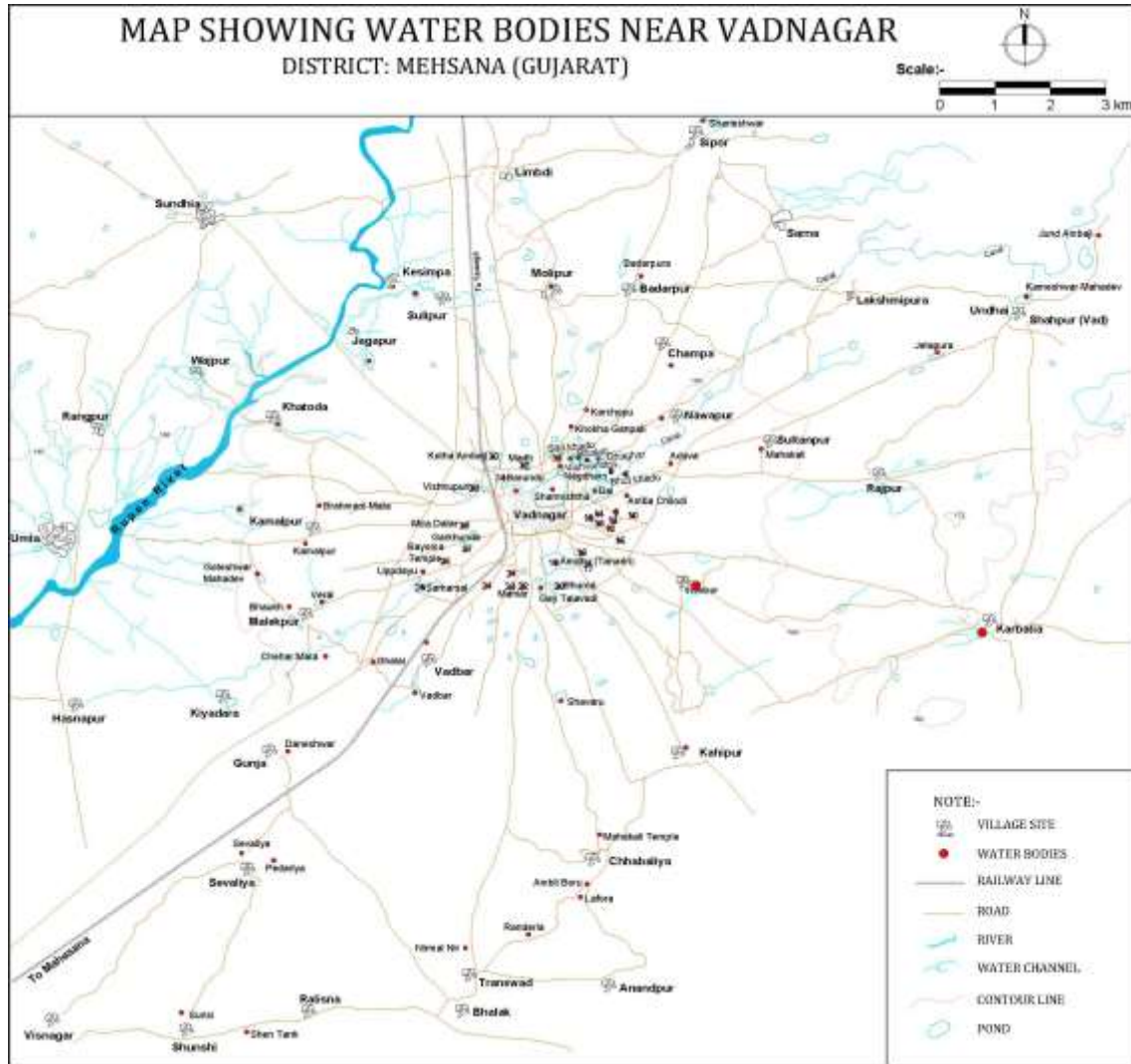


Figure 8: Map showing water bodies within 10 km radius of Vadnagar and Rupen River on the north-western side

Among the objects found, one of the major discoveries at Vadnagar has been the abundance of shell objects at every manufacturing stage. It has also brought about the evolution and complexity in the design and pattern of shell bangles. The first comprehensive study on shell objects in the historical context was conducted in Vadnagar (during field season 2016-19). The study revealed that this town was the largest shell manufacturing centre throughout history. The study reveals that a substantial quantity of shell artifacts in different stages of production were found in Vadnagar. None of the sites in India have yet presented the wide variety of decorations and designs that are discovered here (Figure 9). Another significant finding of the study was the reappearance of shell craft activity after a hiatus from the post/late Harappan period.



Figure 9: Vadnagar- a shell manufacturing centre

It has also been observed that religious structures from ancient periods were reported to be either outside the fortified town or within the fortification wall's peripheral area (within the town). Excavation and exploration at Taranga have identified it as the largest Buddhist settlement of the late historical period in Western India, where Buddhism survived up to the 14th century CE. Vadnagar was the closest town where they could get logistical assistance.

Scope of the Work

After achieving the objectives of the excavation and completing the illustrative excavation report across two volumes for the successive field seasons of 2016-2019, the findings gained importance, and an innovative concept of Experiential Museum was introduced to bring these findings to the public. Visitors to any archaeological site can usually only walk through it. However, here the visitors would have access to go down to view subterranean archaeological remains from various cultural time frames. Along with this experience, the findings will be displayed in a well-designed museum building in an adjacent area.

To fulfil the objectives of this Experiential Museum, a large-scale excavation was planned from the 2019 excavation field season onwards.

Limitations and Challenges of the Excavation Undertaken for the Creation of Experiential Museum

To ascertain the result of the excavation for the creation of the Experiential Museum, a grid formed by 24 units of 10m x 10m land has been laid out. Since the excavation area was so extensive, a timeline with definite deliverables was prepared to conduct the excavation in two successive field seasons. A tentative project schedule for the completion of the Experiential Museum project was formulated, and responsibilities

were assigned to the multiple organizations accordingly. ASI commenced their work as assigned to excavate this project.



Figure 10: High Raised Structures and Narrow Lines at Vadnagar

Excavation work was expected to begin in November 2019. However, due to unforeseen events of the pandemic and the subsequent lockdown, work related to land acquisition and excavation was delayed. Excavation work resumed after the completion of the land acquisition process in mid-October 2020. Excavations would be carried out across the grid to expose cultural remains from seven consecutive cultural periods. This would entail excavating 70% of the trenches (each measuring 10m x 10m) to a 5-10m depth.

Limitations and Challenges

1. The habitational deposits (cuttings) of excavated trenches are man-made, and due to their fragile nature, they are prone to collapse. In response, it must be protected from any type of natural or artificial water percolation.
2. All brick-made structures must be strengthened/consolidated concurrently with excavation. This is necessary to maintain the strength and preservation of the ancient structures.
3. All the missing or dilapidated portions of the exposed structures must be conserved with similar materials.
4. Excavated remains from periods I and II (pre-2nd century BCE to the beginning of CE) would be difficult to expose. This is because the water table in Vadnagar is high, and water-logging problems (along with space constraints) would emerge beyond a depth of 16m to 17m. This prevents further excavation.
5. The excavated structures from periods III to Pd. V have been found to have followed the plumb-line of their predecessors. It would thus be difficult to showcase them separately. However, efforts are made to define the various cultural periods based on their cultural materialism.
6. Before the arrival of the monsoon in 2021 and 2022, suitable temporary sheds were erected on the excavated area of the site.

With these challenges and limitations, excavation was confined in two locations.

Location 1: North-eastern corner of the fortified town, locally known as Ambaghat (Amarthol locality). This excavation was planned to meet the goals of the proposed Experiential Museum.

Location 2: South-western corner of the Kotha Amabaji lake (near Anaj Godown). This excavation continued to expose religious structures on plan.

Location 1

To achieve the goal of the proposed museum project, the acquired area was divided into a grid with 24 units of 10m x 10m each. The grid layout cutting across the northeastern part of the fortification wall connects with the habitation area. Such a grid layout pattern was used to shed light on the construction phases of structures and their correlation with

the various phases of the fortification wall. The pegs were fixed in the north-western orientation, covering an area of 3,200 sqm (Figure 2).

Cutting of 2019-20 Field Season

As previously stated, the excavation at Location 1 (Ambaghat) and Location 2 (south-western corner of Kotha Ambaji Lake) was conducted concurrently during the 2019-20 field season. Due to the ongoing land acquisition process, three grids were laid out at Location 1. These three grids that were subjected to excavation were A1/33/55 to A1/33/75, located along the fortification wall (northern segment). The excavation was temporarily terminated on 22nd March 2020 due to the first wave of the Covid 19 pandemic. When the lockdown was lifted in May 2020, it was observed that the excavation in Location 1 could not be resumed due to a lack of manpower. Complying with social distancing norms was not feasible with the required high number of Human Resources. As a result, it was decided to limit excavation to Location 2.

Cutting of 2020-21 and 2021-22 Field Seasons

Location 1: Since the land acquisition process was complete, the excavation resumed in November 2020 by laying down new trenches. Overall a grid with 24 units of 10m x 10m was subjected to excavation and an extensive digging operation was conducted to expose structures at different levels, and further understand the layout of streets and lanes. The excavation of these grids has revealed features that indicate a significant shift in strategies of town planning from the 12th / 13th century CE and beyond. Before this period, structures were raised above one another by maintaining the plumb line of their preceding structure. This resulted in high-raised walls that have become the identity of the excavation at Vadnagar. The surface features indicated the presence of a network of lanes. As found in one of the cuttings (A1/33/63), these lanes had no surface treatments and formed T- junctions. High-raised structures were built on either side of the 3.4 m wide street that ran east to west. Narrow lanes were formed as a result of the construction of additional structures, either abutting or nearer to the main structure (Figure 10).

As previously stated, the high raised brick walls that were built over the plumb-line of its predecessor structure have been exposed in 7 trenches. In one of these trenches (A1/33/63), this feature (12m in height) was traced up to a depth of 16.16m (which appeared at a depth of 4m). In between these high-raised walls, narrow lanes with a width of 1m and roads with a width of 3.4m were recorded. During the cutting, it was found that a platform-like arrangement was provided abutting the walls along the roadside. Similar to the present houses in Vadnagar, a platform facing the roadside, known as *Otlo*, was used to sit and socialise. As evidence found during excavation suggests, this tradition can be traced back to ancient times and is one that has continued to the present. This is indicative of a continued development of culture, with some aspects of lifestyle retained over centuries being reflected in the built form.

The excavation of residential structures along the fortification wall (A1/33/93 & A1/43/03) revealed information about an opening in the brick structure (initially 4.5m

wide, further narrowing down to 2m, and then completely closed – period VI), probably towards the roadside, measuring 3.7m wide, which runs parallel to the fortification wall. Underneath this last structural activity, a brick structure of the preceding phase with a curved corner of the wall indicates a smooth turning of the lane or the road. The closing of the opening towards the road indicates that access to the town was completely closed in Pd. VII (17th/18th – 19th century CE).

A similar phenomenon was observed in period IV (late phase) and V (10th-13th century CE – early level), where an initial opening of 1.60m was narrowed down to 70 cm and then eventually closed. A new opening of 80cm was recorded beside it, where the bricks lining it have worn out (with rounded edges), most likely due to public/animal movement.

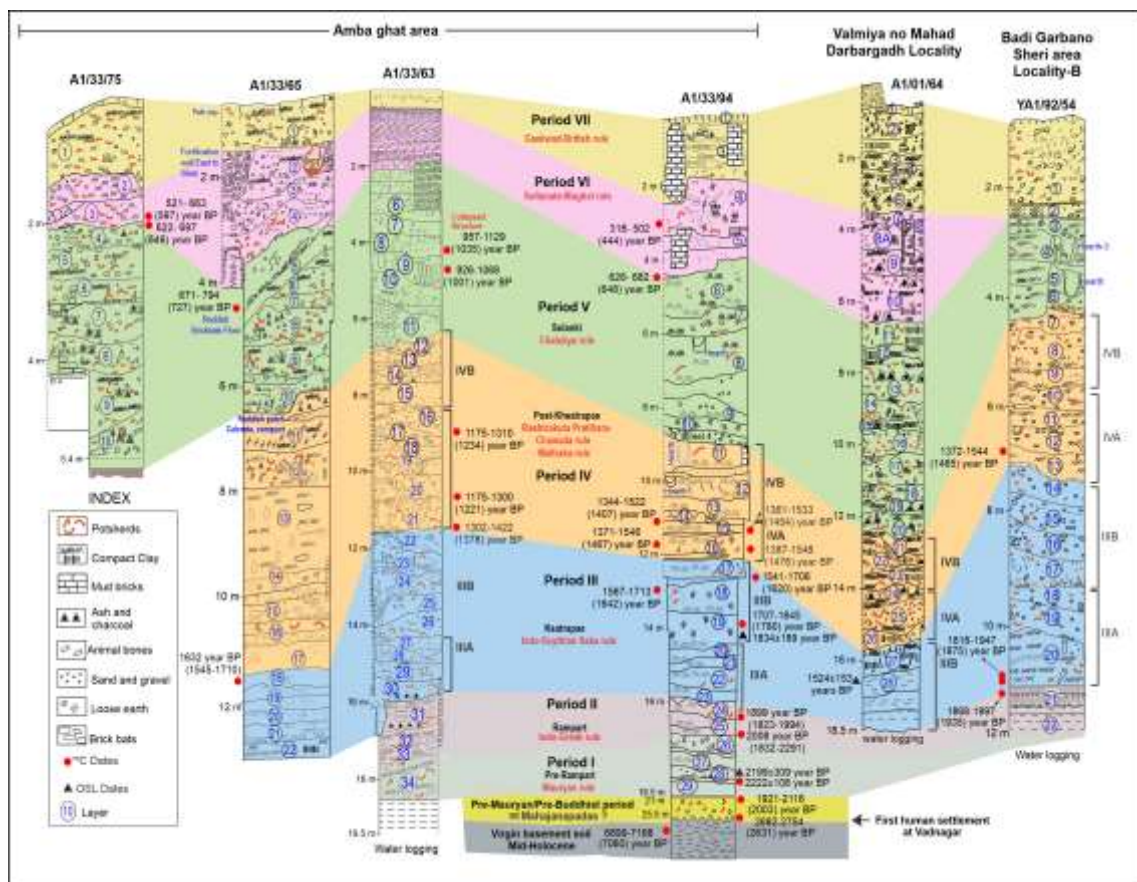


Figure 11: Stratigraphic positions of cultural periods (lithologs)

Location 2: On the south-western corner of Kotha Ambaji Lake (near Anaj Godown), two grids were subjected to excavation. Among these two quadrants of both grids are ZB1/97/18 (Q III & IV) and ZB1/97/17 (Q I & II), located in the western periphery of the mound. The excavation revealed a habitational deposit that was 3.5 to 4 m thick. All four quadrants were excavated before the first lockdown imposed in March 2020. Aside from these quadrants, a part of the northeastern corner of the mound was also under operation, of which trench ZB1/97/48 (Q II) was taken up for the excavation.

This highly damaged mound was bifurcated into two divisions by a road across the mound. Further, the construction of Anaj Godown caused damage to the entire southern periphery. However, a strip of the mound along the road, where remains were previously noticed, was selected to lay out trenches. The goal of continuing excavation in Location 2 was to-

1. Study the chronology of the site to understand the town's expansion beyond the fortified area, and
2. Study the nature and details of the structures (religious typologies, if any), as it was observed that religious structures were found within the fortified town but confined to the area along the periphery of the fortification wall or outside the town rather than being located along the banks of lakes.

Following the relief of the first lockdown in May 2020, the excavation work resumed in this location (Location 2), and the area of excavation was extended. The trenches were laid out, and among them, the following quadrants of the trenches were identified as areas where excavation would be underway- ZB1/97/18 (Q III & IV), ZB1/97/28 (Q III & IV), ZB1/97/38 (Q I, II, III & IV), ZB1/97/48 (Q III & IV), ZB1/19/58 (Q I, II, III & IV), ZB1/19/47 (Q I & II) (Figure 3: grid plan of Anaj Godown site).

The stratigraphy of the above-mentioned grid cutting from Locations 1 and 2 broadly defined the stratigraphic position of all structures, correlating it with the various phases of construction or alteration of the fortification wall, average deposits, and the digging depths.

Cultural Sequence and Chronology

The excavation for the field season 2016-19 at the site has formulated seven cultural periods, its cultural chronology was based on the absolute dating as well as cultural assemblage. Overall, while preparing chronology for the field season 2019-22, data generated for the previous field season has also been taken into consideration. Based on which, a data sheet of stratigraphic positions of cultural periods (lithologs) has been prepared evaluating all important cutting. Lithologs of six trenches i.e. Locality C (southern side of fortification wall- Ghaskol area; YA1/72/85), Amba Ghat (northeastern corner of the town; A1/33/63, 65 and 94), *Valmiya no Mahad* (Darbarghad area; A1/01/64) and Locality B (*Badi Garba no Sheri* area; YA1/92/54) showing spatial correlation of the seven cultural periods along with the median AMS radiocarbon dates and calibrated age ranges. Besides, deep cutting through the trenches, specifically the A1/33/63 and A1/33/94 has exposed all the seven cultural periods from Period I to Period VII (Figure 11).

The cultural deposits of period I (pre-Rampart period), contemporaneous to pre Mauryan and Mauryan rule were found beneath the rampart. The ceramic tradition of this period is dominantly comprised of medium to small size Red Ware, Red Slipped Ware and Black and Red Ware. The simple -shaped, and less-decorated ceramics were

made on slow to medium wheels. Shapes consist of the globular pot, jar, basin, bowl and lid. Simple varieties of shell bangles carved from *Turbinella pyrum* (coastal marine gastropods) were present in Period I, which continued in the subsequent periods (up to period V) (Figure 12).



Figure 12: Cultural materialism at a glance

Evidence of the first defence structure around the town (Rampart) was found in the period II termed as Rampart period, indicating flourishing of the town. The rampart was made of calcareous and black clay. Gujarat went under Indo-Greek rule during this period. The coinage resembles central India with copper coins bearing the Ujjain symbol and swastika motif. Although 36-coin moulds of the Indo-Greek king Apollodotus-II was also yielded from Vadnagar but not recorded from this horizon. The ceramics gradually refined from the preceding period. Terracotta bangle with deep diagonal incised lines emerged during this period.

Indo-Scythian or Shaka rule started during Period III of the Vadnagar settlement. Their kingdom was divided into smaller provinces and units and was ruled by 'Satraps' or 'Kshatrapas', meaning governors (Moray 1985). This period is thus named as Kshatrapa period. The Indo-Scythians are one of the central Asian tribes, who invaded India, displacing the preceding Indo-Greeks. The Kshatrapas of Gujarat (Western Kshatrapas) was contemporaneous to Kushans of the northern India and Satvahanas of central India. The brick fortification wall around the site built at the beginning of the period III. India witnessed a spur in Buddhist activities during this period. The structural plan of the excavated Buddhist monasteries near Ghaskol gate, belonging to this period, is comparable with the monasteries reported from Sanchi, Sirpur, Taxila and Koluha. The monastery appeared to have been constructed around the 1st century CE based on the contemporary appearance of Red Polished Ware pottery (Rawat 2011). Other Buddhist structural remains are Elliptical structure along with circular and square stupas are also reported from this period.

This era was characterized by the continuous conflicts between the Satvahanas and the Kshatrapas. Evidences of catapult balls from this period might indicate continuous

push-pull between these two dynasties. A sturdier brick-built fortification wall emerged in this period. Burnt bricks became common as architectural elements. The structures built with high raised walls, which is a peculiar feature of Vadnagar town, were found to be existent from this period. This period is subdivided into Period IIIA and IIIB, based on cultural assemblages. These Indo-Scythians rulers continued the preceding culture as evidenced by the excavated material remains. A new kind of ceramic assemblage, Red polished ware, was introduced. The late phase of this period (III B) witnesses the introduction of Black Burnished Ware. The decorations became more complex, consisting of sherds having applique, incised and stamped design. Rang mahal type paintings were also observed, which continued in the succeeding periods. The shell industry, with the introduction of new types of grooved bangles, also got well established by the end of this period (III B), as also evidenced from a large number of *T. pyrum* debitage. Copper, silver, and lead coins of the Kshatrpa ruler Bhumaka, Kardamaka Kshatrpa were found. Based on coinage, this period is designated as the Kshatrpa period. The epigraphical findings were two seals having symbols of the six arched hills, crescent surrounded by the inscribed legend. These can paleographically be dated to the 2nd -3rd century CE.

Period IV (post-Kshatrpa period) started with the modification and elevation of the fortification wall. Based on ceramic studies, this period is divided into sub-periods (IV A and IV B). Period IV A was the most prosperous period at Vadnagar, as evident from the rich material culture. During Period IV, Vadnagar seems to be come under the rule of Maitraka dynasty, who were probably the vassals of early Guptas (400-470 CE), but later became an independent power. The cultural assemblages of the Period IV A, were at their peak with a large number of different new types of shell bangles as well as *T. pyrum* debitage, indicating flourishing of shell industry. The post Kshatrpa period is also marked by an exponential increase in the number of lead coins. The characteristic coinage of this period is the uninscribed lead coins. The predominant motif on the obverse side is Garuda with spread wings. A coin hoard with 249 lead coins was found from this cultural period (2016-17). Excavation along the Eastern side of Sharmistha Lake found impressive brick structures. During the early phases of this period, Chocolate Slipped Ware, Kaolin Ware, Black Slipped Ware and imported Turquoise Blue Glazed Ware and Torpedo Jars were newly introduced in the ceramic tradition along with the continuation of previous types. Other characteristic features are having certain sherds with surface treatment of gold and silver mica wash, grooved rims of the globular pot, 'V' shaped bowls (which became dominant in the subsequent period), long humped spouts and Red Slipped Ware sprinklers. The decoration of this phase comprises of the dominance of Rang Mahal type as well as brown painting on white and buff background and some with bi-chrome having geometric and naturalistic form.

A gradual decrease in the quantity and quality of shell bangles and *T. pyrum* debitage is observed during the Period IVB. During Dhruvasena Maitrak of the Vallabhi-Maitraka dynasty, the famous traveller Xuanxang visited at ~ 1310 BP (640 CE). He described the town as densely populated with a rich establishment, Buddhist activities, and the

presence of ten Sangharamas and several temples (Beal, 1884). By end of this period, Buddhist establishments came to an end. By this time, the town had also come up with a number of water bodies, presumably to sustain the climate vagaries. Thick calcrete layers were observed in the cultural deposits of this period, indicating dry climatic condition (Figure 13).



Figure 13: Intermittent calcrete layers Trench A1 33 85, section facing east

During this sub-period of period IV, political instability and an urban decline started all over India, after the downfall of the Guptas, whereby several petty kingdoms emerged along with cultural deterioration, destruction by the invading Hunas, a decline in trade (Dhavalikar 1999, Singh 2008). The upper part of the fortification wall of Period IVB was found bulging outward, showing deterioration. After the Maitraka rule, the reign of Gujarat is followed by the Rashtrakutas and then by the Gurjara-Pratihara and Chavada dynasty. The later part of Period IVB, is historically contemporaneous to the 'Tripartite struggle'. This struggle was between the three great powers, namely, the Rashtrakutas of the south, the Pratiharas of the north and the Palas of the east to get control over Kanauj (Majmudar M R, 1960, 219).

After the end of the 'Tripartite struggle', the rule of Gujarat passed into the hands of the Chalukya/ Solanki dynasty. During this period, i.e. Period V, the layout pattern of the town was altered, and its fortification system was further strengthened. This major repairing of the fortification wall can be correlated with the Arjunbari gate inscription of the Solanki ruler Kumarpala. The ceramic assemblage of this period consists of regular wares of the previous periods with the new addition of decorated Mica Washed Red

Ware and Grey Ware, Cut Ware and other two significant wares of thin section and glossy surface, namely Fine Red Slipped Ware and Chocolate Slipped Ware. Torpedo jar sherds too reported (from early level). During this period the trade and commerce flourished, and specialized craftsmanship in the production of high quality intricately carved shell bangles which were not observed before. The shell assemblage, shell bangles are of incised decoration variety and perforated decoration variety, the latter being the major change in the decoration pattern observed during this period. Although almost all the varieties of shell bangles occur in this period, there is a further decrease in its numbers. Similarly, the quantity of shell debitage also drops drastically. The reign of the Solanki dynasty at Vadnagar had been prosperous and brought political stability as well as considerable cultural developments regarding architecture, language and scripts. The Rudramala temple, Sun Temple at Modhera, step well of Rani ki Vav at Patan and the Toran at Vadnagar were built. The *Vadnagarprasasti* from Kumarapala's reign reveals the Chalukya kings' desires to be viewed as superior to their eastern neighbours praising them in many different ways and goes on to describe the virtues of Anandanagara (modern Vadnagar), the traditional settlement of the Nagars, a prominent Brahmin community in Gujarat (Ojha and Buhler, 1892). A stepped bank was created around Sharmistha lake to use it as a water-retaining system (Burgess 1903). A brick-built water storage structure was also found from this period. Large number of characteristic Indo-Sassanian coins of this time has been found from this period indicating prosperous conditions.

During the following period VI, Gujarat passed under the Medieval Muslim rulers, including Sultans and Mughals. During this period, semi-circular bastions were added to the fortification wall. The ceramic tradition is marked by an increase in the quantity of Grey Ware and Black Burnished Ware and a corresponding decrease in Red Ware and Red Slipped Ware. Introduction of glazed ware, celadon ware is observed during this period. The most noteworthy feature is the decline in the concave-shaped neck while the constricted shaped neck becomes dominant. Another remarkable feature of this period was the replacement of shell bangles with glass and ivory bangles. A similar feature of decreasing shell bangles is observed at many medieval sites across the subcontinent. During this period, economic conditions at Vadnagar might have deteriorated due to the political instability brought about by the rising powers of the Sultans of Gujarat and the Mughals. This may have also affected its major craft industries like shell working, which came to an end. No definite factors can be attributed to this aspect. The replacement might reflect the cultural difference between the Central Asian newcomers and Indian civilization. A decline in the use of shell bangles could be due to the scarcity of shells caused by centuries of intensive exploitation, which had affected their availability. While this could be one factor, likely, continued severe aridity during this period had also affected the *T.pyrum*'s natural habitat in the Gulf of Kutch. Although large numbers of copper and silver coins of Islamic rulers were found from this period, cowries were also probably common as trade currency which in turn indicate a fall in economic condition (?). In this period, a rapid increase in the construction of step-wells across Gujarat strongly attests to severe drought-like conditions. At Vadnagar, the *Pancham*

Mehta ni Vav, a beautiful seven-storey step-well, was built by a local leader, Pancham Mehta, in the 16th century for providing drinking water to travelers and dyeing the fabric. *Ain-e-Akbari*, a 17th century C.E. biography of the Mughal ruler Akbar, mentions about number of water bodies around the town with a temple (Jarrett, H.S. 1873). The possible reason for a large number of water bodies was for conserving the rain water to sustain agriculture which depends totally on the irregular monsoon rain in this area.

The last renovation to the fortification wall and construction of steps for access to one of the bastions was made during Period VII. During this period, Gujarat comes under the Imperial rule of the Gaekwads, who finally gave way to the British rule of India, leading to the Independence struggle and state formation at a later time. The common wares and shapes of the preceding periods are continued in this period, however with a decreased quality and limited varieties. The coins of the Gaekwad period include a variety of coins of both Indian and British rulers. Silver coin of Anandrao, the Maharaja of Baroda from the 18th-19th century, along with copper coins of George V (1917 Calcutta mint), silver coin of Edward VII (1904 British India) and 19th-century coin hoard of 25 silver and copper coins were found. This horizon witnesses a drastic decrease in the quantity of beads compared to the preceding period. The beads made of stone, glass, Terracotta, shell and seed in limited shapes have been reported.

AMS Radiocarbon Dates: Results

The cultural sequence at Vadnagar is >20m thick shows the lithologs of the six trenches and the spatial correlation of the seven cultural stages. The earliest pre-Rampart cultural level (period I) observed at a depth of 18 to 19 m downwards in the excavated section did not have any fortification and can be placed contemporary to the pre-Mauryan to Mauryan period. A drill core was raised from the base of period-I that contained fragments of bricks and potteries lying over virgin soil basement devoid of any archaeological remains. The contact between the soil and the overlying period-I marks the first human occupation at Vadnagar. The pre-Rampart period was successively overlain by Rampart (period-II), early and late Kshatrpa (period III A and III B), post-Kshatrpa (period IV A and IV B), Solanki (period-V), Sultanate-Mughal (period-VI), and Gaekwad/British colonial (period-VII) each with distinct cultural identities (Figure 14). From elementary stage the settlement evolved from a city with rampart through brick fortification to semi-circular bastion of Islamic architecture. During its early part the city came under different rulers from contemporary to pre to Mauryan then Indo-Greek through Indo-Scythian (Bactrian Shaka). This was followed by the Kshatrapas, Maitraka, Solankis, Islamic and finally Gaekwad/British colonial rule. Along with the change in political landscape, various cultural (e.g., ceramics, architecture) and religious infusion occurred at Vadnagar. An important discovery is of a burnt brick structural complex with stupas (elliptical congregation hall) and brick stupa along Sharmistha.

Chronology

Twenty-five samples retrieved from six trenches were radiocarbon dated by accelerator mass spectrometry (AMS) (Table 1). The materials included Charcoal, *T. pyrum* bangle

debitage, soil, and *Bellamyia* shells. For comparison, a modern *Bellamyia* collected from Sharmistha Lake was dated that gave a radiocarbon age of -111 ± 34 years, indicating the reliability of dating freshwater shells or other bio-accretionary carbonates.

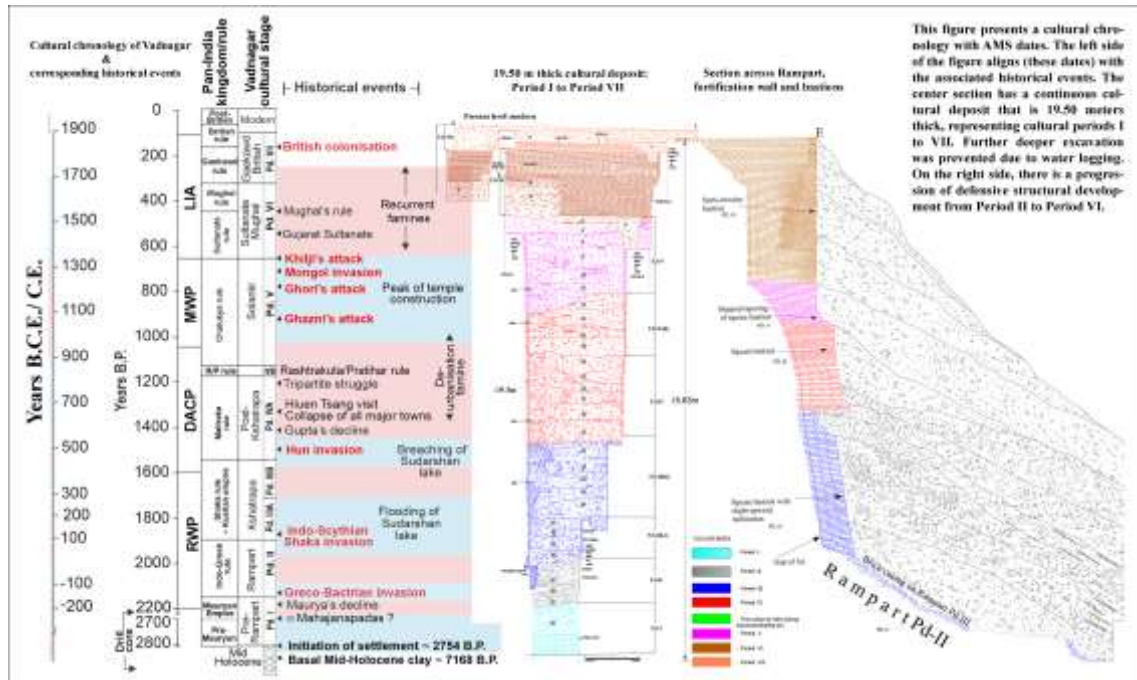


Figure 14: Cultural chronology of Vadnagar and Associated Historical Events

Table 1: Cultural sequence of Vadnagar - a continuous human habitation at the site and their chronological positions: radiocarbon dates by accelerator mass spectrometry

Phases	Stratigraphic defence structure and association	Cultural affiliation and contemporaneous	dynastic and	AMS date Cal. BP		
				Radiocarbon Age (years BP)	Calibrated age Range (2σ) (years BP)	Median Age (years BP)
Natural soil (drill core sample)	Virgin soil	Period Mehrgarh (5000-4500 BCE) Ceramic Neolithic	II of	6163 ± 55	6899-7168 (0.967) 7213-7242 (0.033)	7060
Phase – I mid 7 th - 2 nd cent. BCE	Pre - Rampart	Pre-Maurya (Mahajanapada) and Maurya		2553 ± 38	2494-2599 (0.404) 2612-2645 (0.144) 2682-2754 (0.452)	2631
						2222±108 (OSL)
						2199±309 (OSL)

Phase- II 2 nd cent. BCE to 1 st cent. CE	Rampart	Indo-Greek & Shunga, Mahameghavahana (Kharavela)	2053 ± 38	1891-1908 (0.027)	2003	
			2054±61	1832 - 1856 (0.025)	2008	
				1865 - 2150 (0.954)		
				2270 - 2291 (0.022)		
			1998±29	1838 - 1853 (0.040)	1935	
		1868 - 1997 (0.960)				
		1823 - 1994 (1.000)	1899			
Phase- III 1 st - 4 th cent. CE	Brick fortification wall	Kshatrapa: Kushana, Satavahana Gupta	and	1966±27	1827 - 1946 (0.917)	1896
					1962 - 1986 (0.083)	
				1949 ± 34	1747 - 1765 (0.031)	1875
					1781 - 1814 (0.057)	
					1816 - 1947 (0.859)	
					1962 - 1986 (0.053)	
				1950±30	1748 - 1762 (0.017)	1876
					1787 - 1812 (0.033)	
					1818 - 1946 (0.906)	
					1962 - 1986 (0.043)	
		1834± 189 (OSL)				
		1734 - 1884 (1.000)	1803			
		1707 - 1845 0.942	1780			
		1849 - 1872 0.058				
		1548 - 1555 (0.019)	1642			

				1557 - 1564 (0.016)	
				1567 - 1713 (0.965)	
Phase – IV 5 th – 9 th /10 th cent. CE	Raised further height of fortification wall. post- Kshatrapa	Gupta, Maitraka, Chavada, Maukhari, Badami Chalukya Rashtrakuta, Pratihara, Pala and Hindu Shahis (Afghanistan)	1743±39	1545 – 1710 (1.000)	1632
			1730±40	1541 - 1706 (1.000)	1620
					1524 ±153 (OSL)
			1609 ± 40	1387 - 1548 (0.993)	1476
				1554 - 1558 (0.003)	
				1563 - 1568 (0.004)	
			1592±45	1371 - 1546 (1.000)	1467
			1589 ± 45	1372 - 1544 (1.000)	1465
			1566 ± 45	1361 - 1533 (1.000)	1454
			1531 ± 42	1314 - 1324 (0.018)	1407
				1344 - 1522 (0.982)	
			1501 ± 48	1302 - 1422 (0.823)	1378
				1432 - 1446 (0.023)	
				1448 - 1476 (0.077)	
				1484 - 1516 (0.077)	
			1295 ± 49	1075 - 1098 (0.032)	1221
				1119 - 1164 (0.111)	
				1175 - 1300 (0.856)	
			1318 ± 52	1078 - 1093 (0.012)	1234
				1121 - 1163 (0.069)	

				1175 - 1310 (0.912)	
				1332 - 1341 (0.007)	
Phase – V 10 th -13 th cent. CE	Rebuilding of fortification	Solanki: Vaghela, Parmar, Chandela, Yadavas of Devagiri, Gahadavala, Ganga, Kadamba, Hoyasala, Chola, Chera and Pandya	1140 ± 39	957 – 1129 (0.935)	1035
				1160 – 1176 (0.065)	
			1095 ± 39	926-1068 (0.992)	1001
				1170-1174 (0.008)	
			824±44	671 – 794 (0.989)	727
				889 - 897 (0.011)	
Phase –VI 14 th – 17 th cent. CE	Semi-circular bastions and repair to fortification along Sharmistha lake	Sultanate, Gujarat Sultan and Mughal: Vijayanagara, Rajput, Deccan Sultanate, Ahom kingdom, European powers, Maratha,	696±52	554 - 613 (0.355)	649
				622 - 697 (0.604)	
				703 - 722 (0.041)	
			687±38	557 - 596 (0.367)	648
				626 - 682 (0.633)	
			591±61	521 - 663 (1.000)	597
			579±62	514 - 658 (1.000)	594
			378±30	318 - 392 (0.393)	444
				425 - 502 (0.607)	
Phase–VII 18 th -19 th cent. CE	Steps to the bastion	Gaekwad: Maratha, East India Company, Portuguese and French	-		
Modern (Bellamya Shell)			111 ± 34		

AMS dating carried out by Prof. Sarkar at PRL Ahemadabad and OSL by Dr. Rajesh Agnihotri from Wadia Institute of Himalayan Geology, Dehradun

The earliest settlement at Vadnagar occurred at 2754 yr. B.P. (754 BCE) just above a ~7168-year-old mid-Holocene virgin soil that did not yield any archaeological remains. The contact between this soil and the age of the first layer of settlement marks a

geological hiatus and suggest that first human habitation at Vadnagar started during the Early Iron age or close to the second urbanization phase of Mahajanapadas (2550-2300 yr. B.P./550-300 BCE.; Chakrabarti, 2000). Designated as pre-Rampart Period-I this period pre-dates both Buddhism and Jainism, and continues till 2150-year B.P./150 BCE., spanning the rise and fall of Mauryan Empire. The settlement in this embryonic stage was inherently simple with no fortification, simple architecture and ceramics of Black and Red ware, so typical of the Iron Age/Mahajanapadas of northern India (Singh, 2017). The successive Rampart period II (Indo-Greek rule; 2150-1896 yr. B.P./150 BCE-100 CE), Kshatrpa Period III (Indo-Scythian or Shaka rule; 1896-1548 yr. B.P./100 CE – 400 CE), post- Kshatrpa period IV (from Maitraka rule contemporary to Gupta rule to Rashtrakuta-Pratihara-Chavada rule; 1548-1068 yr. B.P./400 CE – 900 CE), Solanki period V (Chalukya rule; 1068-697 yr. B.P./ 900 CE – 1300 CE), Sultanate-Mughal Period VI (697-318 yr. B.P./1300 CE – 1700 CE), and Gaekwad/British Period VII (318 yr. B.P. to British colonial period/ 1700CE-1900 CE) makes Vadnagar a unique multi-cultural archaeological site.

Globally the last two millennia experienced periodic warming and cooling conventionally designated as Roman warm period (RWP; 2500-1600yr. BP/ 500 BCE - 400 CE), Dark Age cold period (DACP; 1600-1050 yr. BP/ 400 CE – 950 CE), Medieval warm period (MWP; 1050-650 yr. BP/ 950 CE – 1350 CE), and Little ice age (LIA; 650-100 year BP / 1350 CE – 1900 CE; Mann et al., 2009; Werner et al., 2019). Accordingly, Period-I to mid-Period III-B, early Period IV-A to late Period-IV-B, early Period-V- to late Period - V, and Period-VI to VII correspond to RWP, DACP, MWP, and LIA respectively.

Conclusion

The comprehensive excavation at Vadnagar, conducted by the Archaeological Survey of India (ASI) from 2016 to 2019, has significantly advanced our understanding of this ancient town's long and complex history. Covering a 4000m² area on the southeastern bank of Sharmistha Lake, these excavations revealed a continuous cultural sequence spanning seven distinct periods from the pre-2nd century BCE to the 19th century CE. The meticulous work over three field seasons has culminated in a two-volume report and the establishment of an Experiential Museum, which will vividly showcase Vadnagar's rich cultural heritage through interactive displays. The excavations unearthed evidence of sophisticated urban planning, including high-raised brick walls, narrow lanes, and residential structures, highlighting the town's continuous development and resilience. Notable discoveries, such as a rich shell artifact industry, indicate Vadnagar's historical significance as a major shell manufacturing center. The site's advanced water management systems further underscore its ability to thrive despite climatic challenges that caused decline in other regions during the post-Gupta period.

The stratigraphic analysis and AMS radiocarbon dating of twenty-five samples have established a detailed chronology, revealing the town's evolution through various historical periods. From the simple architecture and ceramics of the Pre-Rampart Period

(mid 7th to 2nd century BCE) to the fortified structures and rich material culture of the Solanki Period (10th to 13th century CE), Vadnagar's continuous occupation and adaptation to changing political and economic conditions are evident. The study also highlights the challenges faced during excavation, such as water-logging and space constraints, which made it difficult to expose early period remains. Despite these issues, the extensive excavation efforts have provided valuable insights into the town's expansion, particularly beyond the fortified area, and the nature of its religious and residential structures.

Overall, the Vadnagar excavations illustrate the town's long-standing resilience, strategic significance, and cultural richness. The findings not only contribute to our understanding of Vadnagar's historical timeline but also emphasize its role as a thriving center of commerce and culture through various historical periods. The establishment of the Experiential Museum will ensure that these insights are accessible to the public, fostering a deeper appreciation of Vadnagar's historical legacy.

Acknowledgements

The excavation at Vadnagar was conducted by the Archaeological Survey of India. The authors express their gratitude to the former Secretary (Culture), the former Director-General, Smt. Usha Sharma, and Smt. V Vidyavathi for their support in completing the work. We are also grateful to Shri Govind Mohan (Secretary of Culture) and Shri Ashwani Kumar (Principal Secretary, Govt. of Gujarat) for their encouragement. This work would not have been possible without our excavation team, which comprised Ananya Chakraborty, Ganesh Jawarikar, Roshan Ranjith, Janakraj Rajpurohit, Disha Seth, Sejal Gotad, Bhimraj Varhat, Mukesh Thakor, Vipul Rana, Madhuri Jain, Urvashi Parmar, Kena Patel, Alpesh Thakor, Gency Chaudhury, Kunal Otia, Mahesh B. Thakor, Mahediali Momin and Princy Shah and Akash Prajapati for illustrations. The authors are grateful to acknowledge the sound academic support received from Dr. Amol Kulkarni for the ceramic studies, Dr. Abhijit Dandekar in the numismatic and epigraphy studies, and Dr. Aarti Deshpande Mukherjee for the shell study.

References

- Agnihotri, R., N. Patel, P. Srivastava, A. Ambekar, M. Arif, A. Kumar, B Phartiyal, and A. Kumar. 2021. A new chronology based on OSL and radiocarbon dating for the archaeological settlements of Vadnagar (western India) along with magnetic and isotopic imprints of cultural sediments. *Journal of Archaeological Science: Reports* 38 (2021). 103045 <https://doi.org/10.1016/j.jasrep.2021.103045>.
- Ambekar, A. S. 2019. Excavation report on Vadnagar (Field Season 2016-2019). Unpublished. Archaeological Survey of India. New Delhi.
- Ambekar, A. S. 2022. Continuous human habitation at Vadnagar (Gujarat) for 2500 years: A rationale for artificial water bodies. *Puratattva* 52: 112-120.
- Ambekar, A. S., A. D. Mukharjee and P. Maitee. 2019. The conch shell bangle industry through the ages at ancient Vadnagar: Preliminary observations. *Archaeo+Malacology Group Newsletter -February 2019*. ICAZ. Oxfordshire.

- Ambekar, A. S., A. Kulkarni, G. A. Varkey, A. Dandekar, R. Naik, A. Chakraborty, G. Jawariker, and P. R. Prajapati. 2020. Excavation report on Taranga (field season 2017-18 and 2018-19). Unpublished. Archaeological Survey of India. New Delhi.
- Beal, S. 1884. *“SI-YU-KI” Buddhist Records of the Western World*. Kegan Paul. London.
- Burgess, J. A. S. 1903. *The Architectural Antiquities of Northern Gujarat*. Kegan Paul. London.
- Dhavalikar, M. K. 1999. *Historical archaeology of India*. Books and books. New Delhi.
- IAR. 1954-55. *Indian Archaeology – A Review 1954-55*. Archaeological Survey of India. New Delhi.
- Jarrett, H. S. 1873. *The Ain I Akbari*. The Asiatic Society of Bengal. Calcutta.
- Majmudar, M. R. 1960. *Historical and cultural chronology of Gujarat [From Earliest Times to 942 A.D.] With illustrations and Maps*. Maharaja Sayajirao University of Baroda. Vadodara.
- Mehta, R. N. 1968-69. Sudarshan Lake. *Journal of the Oriental Institute*, M.S. University of Baroda. Vol. XVIII: 20-29.
- Mehta, R.N. 1979. *Medieval Archaeology*. Ajanta Publication India. Delhi.
- Moray, M. S. 1985. *History of Buddhism in Gujarat*. Saraswati Pustak Bhandar. Ahmedabad.
- Ojha, V. G. and G. Buhler. 1892. The Vadnagar Prasasti of the Reign of Kumarapala. *Epigraphia Indica* I: 293-304
- Rawat, Y. S. 2011. ‘Recently found Ancient Monastery and other Buddhist Remains at Vadnagar and Taranga in North Gujarat, India. S. M. S. Chia, B. W. Andaya, and M. J. W. Negara. (Eds.). *Bujang Valley and Early Civilisation in Southeast Asia*. pp 202- 230. Department of National Heritage, Ministry of Information, Communications and Culture Malaysia. Kuala Lumpur, Malaysia.
- Sarkar, A., T. Sengupta, A. Ambekar, R. Bhushan, A. P. Dimri, A. D. Mukherjee, A. Sharma, M. C. Liang, P. S. Jena, A. Chakraborty, P. Sanyal, A. Dabhi, and N. Juyal. 2024. Climate, human settlement, and migration in South Asia from early historic to medieval period: Evidence from new archaeological excavation at Vadnagar, Western India. *Quaternary Science Reviews* 324: 108470.
- Singh, U. 2009. *A History of Ancient and Early Medieval India- from the Stone Age to the 12th century*. Pearson Education India. Chennai.
- Subbarao, B. and R. N. Mehta. 1955. Excavation at Vadnagar in *Journal of the Maharaja Sayajirao University of Baroda* IV (1): 20-35.